NAVAL WAR COLLEGE
Newport, R.I.

UNMANNED AERIAL VEHICLES: OPERATIONAL IMPLICATIONS FOR THE JOINT FORCE COMMANDER

by

F. Karen Coyle

Lieutenant Commander, United States Navy

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: F. Karen Coyle

12 November 1994

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION OPERATIONS DEPARTMENT 6b. OFFICE SYMBOL (If applicable) C	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) NAVAL WAR COLLEGE NEWPORT, R.I. 02841	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

UNMANNED AERIAL VEHICLES: OPERATIONAL IMPLICATIONS FOR THE JOINT FORCE COMMANDER (U)

12. PERSONAL AUTHOR(S)

LCDR F. KAREN COYLE, USN

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
FINAL	FROM _____ TO _____	8 FEB 94	31

16. SUPPLEMENTARY NOTATION A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

UNMANNED AERIAL VEHICLE, DEVELOPMENT TRENDS; CURRENT CAPABILITY; PERFORMANCE; LESSONS LEARNED; IMPLICATIONS

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

THE UNMANNED AERIAL VEHICLE (UAV) IS AN EXTREMELY EFFECTIVE TOOL FOR THE OPERATIONAL COMMANDER, WITH A BROAD RANGE OF POSSIBILITIES WHICH ARE JUST BEGINNING TO BE EXPLORED. ALTHOUGH THE UAV IS CONSIDERED PRIMARILY A TACTICAL ASSET, HISTORY HAS TAUGHT US THAT TACTICAL ASSETS MAY BE EFFECTIVELY UTILIZED ON THE STRATEGIC AND OPERATIONAL LEVELS, AS WELL AS THE TACTICAL LEVEL. WITH THE DOWN-SIZING OF THE MILTIARY AND THE INCREASING NEED TO DO "MORE WITH LESS," OPERATIONAL COMMANDERS WILL HAVE TO DEPEND MORE AND MORE ON ASSETS SUCH AS THE UAV TO COLLECT INTELLIGENCE, CONDUCT BATTLE DAMAGE ASSESSMENTS (BDA), AND POSSIBLY TO CARRY OTHER PAYLOADS WHICH HAVE TRADITIONALLY BEEN LEFT TO MANNED AIRCRAFT.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
CHAIRMAN, OPERATIONS DEPARTMENT	841-3414	C

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

★U.S. Government Printing Office: 1985—639-012

ABSTRACT

The Unmanned Aerial Vehicle (UAV) is an extremely effective tool for the Operational Commander, with a broad range of possibilities which are just beginning to be explored. Although the UAV is considered primarily a tactical asset, history has taught us that tactical assets may be effectively utilized on the strategic and operational levels, as well as the tactical level. With the down-sizing of the military and the increasing need to do "more with less," operational commanders will have to depend more and more on assets such as the UAV to collect intelligence, conduct Battle Damage Assessments (BDA), and possibly to carry other payloads which have traditionally been left to manned aircraft.

Historically, the UAV has been utilized primarily for intelligence gathering, gunfire targeting, and, as demonstrated in the Gulf War, timely and safe battle damage assessment. Each service has operated their organic UAV assets independently and for their individual requirements.

This paper will demonstrate that the UAV can and must be utilized more effectively and that the Joint Force Commander must be aware of its potential uses at the operational level in order to take full advantage of its possibilities.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

"Unmanned systems are part and parcel of the technology revolution on the battlefield - a Soviet perspective verified," says Frank Kendall, Acting Deputy of Defense Research and Engineering for Tactical Warfare Programmes for the US Secretary of Defense. "For the first time, we are giving commanders a real-time view of the battlefield."[1] Major General Paul Menoher, Jr., Commanding General of the US Intelligence Center and School says: "Desert Storm made more friends for UAVs than you can imagine. Now every field commander wants them."[2]

In Desert Storm, only one Pioneer, the short range UAV built by AAI/IAI, was lost to hostile fire out of 1,641 hours of flight and 522 sorties. At least one Pioneer was in the air at all times during the six-week war.[3] The UAV proved that it can provide real-time imagery intelligence without placing a manned system in harms way. Because of these successes, the Department of Defense and Congress decided to make UAV acquisition high priority, and estimated procurements could reach nearly $2 billion by the turn of the century.[4]

With a system such as this, which has proven itself in battle time and again, and which provides the Joint Force Commander (JFC) with so much for so little, it is incumbent upon the Commander to become familiar with UAV capabilities and the vast potential of these relatively inexpensive, low risk assets. With important operational as well as tactical implications, the Commander should also consider and incorporate in

regional Concept Plans and ultimately Operational Plans, the framework for the joint coordination and interoperability of all UAV assets available to him.

Chapter II gives a brief history of the UAV and discusses innovative uses and combat successes in the past. Chapter III delineates the current trends in UAV development, while Chapter IV discusses current capabilities. A quick comparison of the UAV with manned aircraft utilized in the same or similar roles is conducted in Chapter V, with the conclusion that the UAV cannot replace manned aircraft, but can greatly complement them. A discussion of Desert Storm lessons learned and their implications is conducted in Chapter VI. Chapter VII ties all of these topics together with a discussion of implications for the Joint Force Commander. Chapter VIII concludes that the UAV provides the Joint Force Commander with an effective alternative to high cost, higher risk systems, and that he must become familiar with its capabilities and potential operational, as well as tactical, uses in order to most effectively employ this important asset.

CHAPTER II

HISTORY OF THE UNMANNED AERIAL VEHICLE

The basic idea of an Unmanned Aerial Vehicle is certainly not new. In fact, normal radio-controlled airplanes which have been flown by amateurs around the world for years are UAVs. As early as World War II, the Germans' use of radio-controlled glide bombs against Allied shipping was quite successful. If these had been engine powered, they would have been considered UAVs. Even before the beginning of World War II, a U.S. Navy squadron, designated VJ-3, was able to control a type of UAV from a distance to attack a target. In the U.S., development of UAVs began at this time, and continued until 1944, but with the demonstrated success of carrier aviation, the urgency of need for an unmanned aircraft seemed to disappear. Despite this lessening of priority, work began at war's end to guide radio-controlled unmanned aircraft loaded with explosives on to important targets. Drones directed by crude auto-pilot systems with preset programs were also used.[5]

Both radio-controlled and preset auto-pilot UAV systems were improved upon after the war, leading to a wide variety of weapons, including missiles and torpedoes. Most of the UAVs developed at this time, though, were utilized as target systems for training purposes. Military planners began to realize the potential for broadened uses for the UAV, such as reconnaissance, but the airframe was unable to support the bulky systems required for these missions.

With the invention of micro-electronic circuitry, the weight and size problems disappeared. Reconnaissance UAVs were first utilized in the Vietnam War, when it was seen that manned aircraft were being lost too frequently. The jet-powered AQM-34 Firebee was the first UAV to see service. It was air launched and air-recovered, and proved to be the perfect vehicle for general reconnaissance and damage assessment missions. These vehicles were able to make multiple passes over an area at low altitudes, altitudes that would have assured the loss of larger manned aircraft, and retrieve outstanding photo-reconnaissance information. Long range photo-reconnaissance missions were flown regularly on pre-programmed courses over China with auxiliary tanks installed on the vehicles.[6]

UAVs were such a success in Vietnam that after the war, planning began for their use in every facet of the military. They were programmed for use in such missions as expanded reconnaissance, bombing, dog-fighting and logistics. Reasons for this mission expansion were that the UAV was far cheaper than aircraft, required no pilot nor forward airfields and used less fuel. Another compelling reason for expanded use of UAVs was their ability to encroach on neutral airspace with minimal risk of political embarrassment since in case of discovery, the country of origin could always claim that the aircraft had run out of control.[7] The momentum given to the UAV program by the Vietnam war ran out within a few years for various reasons. Pilots saw the UAV as a threat to their careers, and the UAV program took money that would have been otherwise utilized for manned aircraft programs. This negative attitude on the part of military fliers led to the lessening

of the budget for UAVs and by 1980, the more ambitious programs had been either shelved, postponed, or cancelled altogether.[8]

With the Israeli invasion into Lebanon in 1982, the UAV once again was in the limelight. The UAV, which was recognized as the key to the Israelis' success against the Syrian air defenses in the Beka'a valley, was utilized for reconnaissance, radar jamming, deception, and above all for target acquisition.[9] The Israelis first used the UAVs with imagery and electronic warfare payloads to locate and characterize Syrian surface to air missiles (SAMs). Then, when they were ready to destroy the sites, the Israelis sent air-launched UAVs into the valley as decoys ahead of ground-attack aircraft firing anti-radar missiles (ARMs). The attack on the Syrian sites was a great success.[10] The UAV system used by the Israelis was the mini-UAV, which was small, slow, simple and inexpensive. The vehicle was not much more than a radio-controlled airplane powered by a 20 hp two-stroke motorcycle engine. The electronic sensor guidance system and advanced control systems, however, were much more sophisticated. The tremendous success of this simple platform focused the emphasis of UAV development away from the more sophisticated jet-powered systems and toward small, inexpensive, and readily expendable systems.[11]

CHAPTER III

DEVELOPMENT TRENDS

Until the middle of 1989, the world was playing by old rules, nations were divided into NATO and Warsaw Pact, and there was no confusion of roles. When the threat scenario changed, military commanders could shift focus and demonstrate a need for new equipment to defend against strong opposition forces. With the fall of the Berlin wall and the crumbling of the Eastern Bloc, the threat level has obviously changed and Western nations along with NATO are having to re-think force level requirements. Because of the reduced threat, military budgets have also been reduced which has prompted service commanders to look for inexpensive alternatives to previously budgeted, expensive items. One of these alternatives is the UAV.[12]

In the past, the terms Remotely Piloted Vehicle, (RPV), and Drone were used to discriminate between an aerial vehicle controlled by a ground-based pilot (RPV) and one controlled by commands stored in the memory of its guidance system (Drone). Many times, though, the guidance systems overlapped, as in the case of an RPV that is initially controlled by a pilot, but when out of range of the control base, continues on a pre-programmed course. The term UAV has recently replaced both of these terms, and reflects this overlapping of systems. UAV systems may be divided into two categories, lethal and non-lethal. The lethal group consists of "smart" weapons, including cruise missiles and fire-and-forget missiles featuring an "intelligent" guidance system. The non-lethal category includes UAVs carrying reconnaissance equipment, passive TV and IR

surveillance systems, relay stations, target designation or ECM equipment, and aerial targets. Signals intelligence (SIGINT) and electronic intelligence (ELINT), radar decoy or high-flying meteorological UAVs are already planned or under operational testing.[13] This paper will look specifically at the non-lethal family of UAVs and will explore their potential for expanded use by the operational commander.

At the present time, only one UAV system is in service, the Pioneer. This system is considered a short-range UAV. A new, updated short-range UAV is to be fielded in the near future which will replace the Pioneer workhorse.[14]

Other systems currently being developed are categorized by range and specific capability. Systems scheduled for development at the current time include the close-range UAV (CR-UAV), the vertical takeoff and landing UAV (VTOL-UAV), the medium-range UAV (MR-UAV), and the endurance UAV (E-UAV).[15]

The CR-UAV will be utilized by lower level tactical units and will be designed to investigate activities within their area of interest and influence. These systems will be easy to launch, operate, and recover. They will require minimum manpower, training, and logistics, and will be relatively inexpensive.[16]

The SR-UAV, (currently the Pioneer system), supports Army divisions, including detached battalion and brigade task forces and corps, Navy and Air Force combatants, and Marine Air-Ground Task Forces (MAGTFs).[17] This system operates out to a range of 150 kilometers or more beyond the forward line of own troops (FLOT) or launch platform, in the case of the Navy. Their endurance does not currently, but should eventually in follow on systems, amount to 12 hours.[18] These UAVs are more versatile, sophisticated, and are

able to carry a wider variety of payloads, can consist of more than one air vehicle, and perform more kinds of missions than the smaller close-range system.[19] Additionally, the SR-UAV is currently deployed in one of two modes, remotely operated through a ground control station, or with a pre-programmed flight path. Extended range may eventually be available through use of GPS or continuous micro-wave data-link relayed through an endurance UAV or satellite. With day and night capability, these UAV systems are designed to maintain surveillance of the enemy at all times. These systems should eventually be able to provide real-time coverage, because they will be tasked, not only with reconnaissance, but also with target acquisition for long-range missile weaponry and aircraft.[20] The SR-UAV will serve as the centerpiece of the overall UAV strategy.[21]

The VTOL-UAV category, formerly referred to as the Maritime or VIPER, will be designed to complement the SR-UAV and will provide a low-cost extension of warship sensors and enhance maritime warfighting capabilities, thereby increasing the security of high value naval assets.[22]

The MR-UAV category addresses the need to provide reconnaissance, both pre and post-strike, of heavily defended targets at significant ranges, augmenting manned reconnaissance platforms by providing high quality, near-real-time imagery. These systems will be designed to fly at high subsonic speeds and spend relatively small amounts of time over target areas.[23] This UAV is due to have an endurance of about two hours and carry a payload of up to 150 kg. It should be able to provide real-time or near-real-time reconnaissance data collected at relatively low altitude under all-weather, day/night conditions. Possible payloads for this UAV include electro-optical, acoustic and IR

sensors, microwave radar equipment, recorders and/or high-speed data-links, among others.[24]

Finally, the endurance UAV category will provide high altitude, heavy payload, multi-mission, and surrogate satellite support across all mission areas with a flight duration in excess of 24 hours. These systems will be capable of employing the widest variety of sensors and payloads in support of joint forces.[25] The endurance UAV may also be used as a continuous micro-wave digital data-link platform for extending the operational range of the short-range and/or the medium-range UAV.[26]

Plans for a stealthy endurance UAV are currently in progress for use by the Air Force. The newly organized Defense Airborne Reconnaissance Office is producing a UAV that will be capable of remaining airborne for days without a need to refuel. This UAV will be utilized specifically to augment satellite assets.[27] Air Force Chief of Staff, General Merrill A. McPeak envisions a large airframe, big pay-load UAV, "that stays there and gives you...continuous rather than episodic coverage like you get with (satellites)." The airframe will carry photographic and synthetic aperture radar sensors for 24 hr., all weather operations, he said.[28]

The UAV development program is coordinated through the UAV Joint Program Office, as established by the Under Secretary of Defense (Acquisition) in response to congressional direction in fiscal year 1988. Through this Joint Program Office, systems are being developed which are inter-operable, and provide for all of the mission needs of the services.[29] The systems described above, with the exception of the Pioneer SR-UAV are currently in the developmental stage, and may or may not eventually be deployed.

CHAPTER IV

CURRENT CAPABILITY

The Pioneer short-range UAV is the only UAV system currently in use in the United States military, (the Pointer system was utilized by the Army during Desert Storm, but is not currently fielded). The Pioneer system was acquired in response to a SECNAV mandate stemming from the recognized need for an inexpensive, unmanned, over the horizon targeting, reconnaissance, and BDA capability. The need for a system such as the Pioneer UAV was identified by commanders in operations including Grenada, Lebanon, and Libya. In July of 1985, the SECNAV directed the expeditious procurement of RPV systems for the fleet using off-the-shelf technology.[30] The Navy was the first service to receive the Pioneer system and immediately began an accelerated testing program which culminated in system deployment onboard the USS Iowa (BB-61) in December of 1986.[31] The Army and Marine Corps also received the Pioneer and began utilizing the system in numerous training exercises. All three services operated the Pioneer UAV during Desert Storm with superlative results. Desert Storm and the employment of the UAV will be discussed more thoroughly in a subsequent chapter.

The Pioneer air vehicle is pusher-propeller driven, powered by a 26 HP, two stroke, twin-cylinder engine mounted in the rear, and utilizes AVGAS as its fuel. The aircraft has a maximum take-off weight of 430 pounds with a mission payload weight of approximately 100 pounds. It has a wing span of 16 feet 9 1/2 inches, a height of 3 feet 3 1/4 inches, and a length of 16 feet 3 1/4 inches. It boasts a maximum level speed of 100

knots, a cruising speed of 48-70 knots, a maximum rate of climb at sea level of 800 feet per minute, and an operational ceiling of 15,000 feet.[32] Its range is currently 100 nautical miles, but with direct data link or control relay, this distance could be increased to at least 300 nautical miles.[33]

The Pioneer was originally purchased as an interim system to fill an immediate need to provide the operational forces with deployable tactical assets. The system provides day and night near-real-time reconnaissance, surveillance, and target acquisition (RSTA), battle damage assessment (BDA), artillery fire correction/adjustment of fire, and battlefield management within line of sight of its ground control station (GCS). The air vehicle's low radar cross section and infrared signature, and its ability to operate by remote control make it particularly useful in high threat environments where manned aircraft would be vulnerable.[34]

The Navy's Pioneer system is currently operated by two ship-deployable UAV detachments of Fleet Composite Squadron SIX, (VC-6). Initially, the system was operated from battleships. With the retirement of these venerable platforms, another platform had to be identified which would both benefit from the battlefield feedback that the UAV could provide and possess the necessary deck space for launch and recovery of the system. The Amphibious Transport Dock (LPD) was selected, and the launch and recovery system was installed initially on two such vessels, USS Denver on the west coast and USS Shreveport on the east coast. A total of eight LPDs will be outfitted for the deployment of this short-range UAV.[35] The inclusion of the UAV on this type of platform provides the Joint

Force Commander with a highly portable, easily deployable asset for immediate in-theater informational feedback.

The Pioneer is also operated by three Marine Corps remotely piloted vehicle (RPV) companies, and one Army RPV company.[36] These companies are also prepared for immediate deployment and, with a few drawbacks such as the need for a prepared landing surface and a cleared area sufficient for the various ground support equipment, are another source for inexpensive, low-risk, immediate in-theater information.

This highly portable, easily operated system could readily be utilized by a Joint Force Commander for the collection of critical operational level intelligence in a period before "national assets" could be realigned for the area of interest. With Navy assets currently able to cover an area approximately 150 nautical miles from the platform ship, and Marine and Army assets deployable from forward land positions, the existing UAV system can cover a large area on short notice if the operating units are pre-positioned in theater.

CHAPTER V

UAVs VERSUS MANNED AIRCRAFT

One of the most important aspects of the UAV is its capability to, in many combat situations, fly into a heavily defended area and send back vital intelligence on the location, disposition, movement, and approximate strength of the enemy without risking a human casualty or an expensive airframe. For the Joint Force Commander, this is an extremely important consideration.

The UAV is not designed to be operated instead of manned aircraft, but as a complement to them. One of the primary reasons that UAV development has not been very rapid is because of the concern of aviators in the military that the UAV might put them out of a job. On the contrary, the UAV may well allow these aviators to survive a conflict to fly another day.

There are several important advantages that the UAV is able to boast over other systems utilized for the same or similar missions. UAV systems are able to gather combat information in real or near real time and transmit it to ground control stations via data link, day or night. This capability reduces the requirement for manned aircraft to fly through heavy enemy anti-air defenses. Transportation and logistic requirements for the UAV systems are smaller than for other airborne intelligence collection resources. UAV systems that are currently in use or in development are interoperable between the services and do not require extensive special training in order to effectively use the information provided by the system payloads. Additionally, UAV systems are designed to interface with existing

intelligence systems such as the all-source analysis system (ASAS) and Joint Surveillance Target Attack Radar System (JSTARS).[37]

When comparing a UAV to a manned aircraft to be utilized for the same mission, the most obvious advantages quickly come into view. Certainly cost, produceability, and expendability are primary considerations. It is much cheaper to produce a UAV than an F-14, and more UAVs can be produced in a shorter time. Actually, the price and effort required for the replacement of an entire fleet of reconnaissance UAVs are considerably less than that for a single F-14.

Some inherent disadvantages have contributed to relatively slow development and employment of the UAV. Two of the primary disadvantages include weather and other environmental restrictions to flight and the requirement for line of sight (LOS) between the UAV and the ground control station (GCS) or relay stations (ground, airborne, or shipborne) processing the aircraft or payload. Future capabilities for satellite data-link or other extended control relay may eventually correct this latter disadvantage.[38] Additionally, the sensor stabilization systems are currently much better in manned aircraft than in the UAV and the quality of the imagery provided by manned aircraft is much better.[39] With the rapid advances made in the area of UAVs, though, most, if not all of these disadvantages should be resolved in the near future.

The military has indeed taken a long time to appreciate the full potential of the UAV. The aviators' perceived threat to their community along with the disadvantages listed above have, for the most part, clouded the vision of the Joint Force Commander and his staff to the myriad of possibilities for the use of this versatile system. The outstanding

performance of the UAV in Desert Storm, although limited in scope compared to its potential, definitely increased the awareness of military leadership and provided impetus for more rapid development of its capabilities.

CHAPTER VI

DESERT STORM PERFORMANCE AND LESSONS LEARNED

On February 27, 1991, the crew of the USS Wisconsin watched on monitors as Iraqi soldiers gave up when a Pioneer unmanned aerial vehicle (UAV) flew near them - thought to be the first time in the history of warfare that humans surrendered to a robot. This incident followed a devastating attack by the USS Missouri on the defenses of Faylaka Island which was guided by UAVs operating from that platform. Officials at the Joint Project Office (JPO) speculate that the Iraqis heard the obnoxious sound emitted by the two cycle engine, because the air vehicle was intentionally being flown low to let the Iraqis know that they were targeted, knew that wherever the Pioneer went, destruction followed in the form of F-16s or 16-in. shells, and felt it best to surrender.[40]

Pointer UAVs, which are small, very low cost, and highly portable, (can be transported by backpack), were among the first equipment to be deployed by the 82nd Airborne in Saudi Arabia. At peak buildup, there were five Pointer and six Pioneer systems in theater, two on battleships, three with Marine Corps companies, and one with an Army platoon. Almost 50 Pioneers flew more than 530 sorties, nearly 1,700 combat hours, with only one being lost to enemy fire. At least one Pioneer was airborne at all times throughout the operation.[41]

The units that utilized the UAVs during the war felt that they were indispensable. A system with "deeper reach" and longer loiter periods would, however, increase the usefulness of these systems. For example, Pioneers could not reach Baghdad where they

would have been most helpful to the intelligence collection effort, flying under clouds, dust, and smoke to provide views not available from satellites or spy planes.[42] A JFACC could easily have employed a long range UAV to collect this critical intelligence.

In addition to these observations, numerous "lessons learned" were derived from this war. Following the war, a conference was held by the UAV Joint Project Office to discuss these lessons learned. Some of the most important are listed below:

- The concept of a family of UAVs is valid.
- The Pioneer air vehicle was very survivable in combat.
- The integration of UAVs into the airspace command-and-control structure was highly successful.
- When combat started, the demand for Pioneer's real-time imagery intelligence exceeded capabilities.
- Constraining UAV operation to airfields is a big limitation.
- A laser target designator on-board a UAV would provide multiple attack options with both precision and non-precision guided munitions.
- Electromagnetic Interference (EMI) between UAV systems and other friendly emitters on the battlefield was a significant problem.
- Dissemination of UAV imagery to multiple users was a significant problem.
- The UAV is a good tool for investigation of JSTARS contacts.
- A high-speed, penetrating UAV with sufficient range and imagery resolution would have been a valuable complement to over-burdened, manned reconnaissance aircraft.
- A long-endurance UAV with appropriate sensors could have played a valuable role in theater missile defense.
- Pioneer is very versatile and responsive to changing priorities in that it was able to very quickly alter its planned mission, even after having been launched on its primary mission.
- Alternate payloads for communications/data relay, electronic warfare, mine/minefield detection, and chemical-agent detection might be needed in future deployments.
- Senior staff personnel, in all branches of the service, need to be exposed to, and develop a greater familiarity and appreciation for the capabilities and limitations of the Pioneer, specifically, and the UAV family, in general, regarding the vital role that UAVs can play in conflict.[43]

Other unclassified observations derived from experience in Desert Storm included the recognition by Special Operations Forces (SOF) that the "use of the RPV provided

extremely valuable intelligence information," and the observation by Commander in Chief, U.S. Atlantic Fleet (CINCLANTFLT), that "remotely piloted vehicles would have been a valuable carrier battle group (CVBG) asset during Operation Desert Storm." CINCLANTFLT went further to recommend that RPV operations be integrated into CVBG capabilities. "The need to obtain a real-time recce platform for missions that would put aircrews and expensive aircraft platforms at undue risk has been clearly established. Ideally, it should be able to transmit location (GPS or INS capable) and day or night image of the target. It should also be able to be forward deployed aboard Cruisers, Destroyers, and other small combatants."[44]

It is clear from the success experienced in Desert Storm by the UAV, that the system is indeed indispensable and, with further development, will provide the Joint Force Commander with a range of options not previously available. These options could provide the edge needed by allied forces to ensure operational success.

CHAPTER VII

IMPLICATIONS FOR THE JOINT FORCE COMMANDER

As has been demonstrated in the preceding chapters, it is imperative that the Joint Force Commander be fully aware of the capabilities of the Unmanned Aerial Vehicle and understand how to best utilize these capabilities at the operational level of war. Although the primary mission of UAV units is to support their service component commands, the JFC, as with all other assets involved in an operation, has full authority to task the UAVs to conduct operations in support of the entire joint force.

Present reconnaissance assets available to the commander are generally large, costly and usually manned, or are satellite systems.[45] These systems are capable and dependable, but they are not always readily available for the immediate feedback necessary for the successful coordination of today's high-tech battlefield. Satellites provide high resolution photographs which can provide much of the information needed for JFC Staff decisions. These are national assets, however, and may not be available because of higher priority tasking, may be limited by weather (cloud cover), or the length of time to get the information from these assets to the supported commander may be unacceptable. The key to success on the modern battlefield is timely information. UAVs can provide the Joint Force Commander with an enhanced capability to collect, disseminate, and exploit combat intelligence information in near real time.[46]

Dissemination of intelligence collected by the UAV may be handled in a number of different formats, depending on the immediacy of need for the information. Formats

include video, freeze-frame, voice communications, recorded message traffic, and digital data. Technological advances have enabled dissemination to be handled even more quickly and effectively today than two years ago in Desert Storm. Initially, only the UAV controller and anyone standing nearby could see the real-time information fed back from the UAV sensors. That information had to be taped and hand-carried to the decision maker, which could take some time, possibly too much time. Today, near-real-time, freeze-frame photographs may be transmitted from the control platform to remote operational coordination sites immediately, and the capability to transmit real-time video imagery, (as the UAV sees it), is available, but the system has not yet been fully deployed.[47] When this real-time imagery transmission system is fully operational, the Joint Force Commander and, in fact, strategic commanders, (President, SECDEF, Chairman, Joint Chiefs of Staff, etc.), will have access to immediate pictures of the theater of operation, thus providing decision makers with information necessary to make quick, well-founded decisions. (Note: The CIA is currently deploying a long-endurance UAV and a ground satellite transmitting station into Albania to monitor troop movements and potential targets in the former Yugoslavia. This system will provide intelligence to U.S. and U.N. commanders real-time via data link.)[48]

Reconnaissance is not the only valuable contribution the UAV brings to the battle, however. Almost every area of concern for the operational commander can be benefitted by the effective utilization of the UAV. Missions that may currently be conducted by the vehicles or that may be conducted in the future include:

*RSTA

*surveillance for search and rescue (peacetime (SAR) and combat (CSAR))
*deception operations
*maritime operations, (including Naval surface fire support, over-the-horizon targeting, ship classification, antiship missile defense, antisubmarine warfare, mine defense support)
*electronic warfare (EW) (including electronic attack (EA)), signals intelligence (SIGINT), and directed energy sensor reconnaissance
*nuclear, biological and chemical (NBC) reconnaissance
*special and psychological operations, (including resupply for special operations and psychological operations teams (scheduled and emergency), and leaflet delivery and broadcast)
*meteorology missions
*route and landing zone reconnaissance support
*adjustment of indirect fires and close air support
*rear area security support
*BDA
*radio and data relay.[49]

Many scenarios which lend themselves to the use of the UAV are primarily tactical in nature, but operational level uses for many of these missions may easily be derived. When conducting the operational planning for a potential conflict, the commander must consider all capabilities of both enemy and friendly forces. All possibilities must be analyzed and the best course of action must be selected. In formulating the actual plans for the battle, standard principles of war, which have been validated time and again in the past, should be considered and made an integral part of the overall concept of operations and operational plan. The UAV is an important asset that should not be overlooked in this planning process. A small part of the big picture, the UAV has been forgotten in the past, for the most part, by the operational commander and his planning staff. The potential for its effective support of many war planning considerations has gone unrealized.

The UAV has demonstrated the potential to complement many of these war planning considerations. For example, the principle of simplicity is certainly embodied in

this versatile asset. This simple, low cost, and easily replaceable system may be tasked on short notice to complete missions in direct support of the JFC. Critical reconnaissance, BDA, or other operational level mission can be efficiently and effectively completed on demand and with very little risk involved.

An extremely effective force multiplier, the UAV can certainly play a key role in supporting the important principle of economy of force. As mentioned earlier, the need for ensuring economy of force in a conflict has never been greater than it is today in this environment of budget cutting and force "right sizing."

The principles of maneuver and surprise may also be enhanced by the operational use of the UAV. The JFC, with the immediate feedback provided by the vehicle, is able to adjust plans to best exploit the current situation and successfully attack the enemy where he is most vulnerable.

With capabilities as widely varied and integral to successful operations as delineated previously, it is clear that the Joint Force Commander should include the UAV in his operational planning and should utilize them in support of the overall operational effort when required.

Currently, the in-theater service component commander, or in the case of the Navy UAVs, the platform ship's Commanding Officer or the Amphibious Group Commander, control the employment of the UAVs in support of the individual service, ship, or group mission. The JFC is able to priority task the systems, but this has not been practiced regularly due to lack of knowledge of the system or actual system limitations. In order to effectively utilize these systems, the Joint Force Air Combat Commander (JFACC), who

should coordinate the operation of the vehicles, should have a UAV advisor on his staff who is knowledgeable in the proper employment of the UAV and who understands how best to exploit its capabilities. As in Desert Storm, the UAV should be tasked and scheduled in the Air Tasking Order (ATO) which will provide for deconfliction of operating areas and prevent accidental redundancy of effort on the part of other platforms. The individual services will continue to exercise tactical control over their assets, but the JFC, with increased knowledge of the system, will increasingly priority task the system to support the overall joint operational effort.

If the Joint Force Commander takes a close look at the operational implications of this highly capable, relatively inexpensive, and near risk free system, and utilizes it effectively, he will recognize a capability multiplier far greater than any other single comparable platform could provide.

CHAPTER VIII

CONCLUSIONS

1. With its proven performance throughout history, most recently in Desert Storm, and the need for the military commander to do more with less in this environment of budget cutting and down sizing, the UAV will become more and more a priority for the Joint Force Commander as an alternative to high cost, higher risk systems.

2. Joint Force Commanders must become familiar with the UAV and its potential uses at the operational level of war.

3. Joint Force Commanders, through their JFACC, must task the UAV to complete operational missions that would otherwise be carried out by more expensive, higher risk systems. This will preserve the high cost systems for combat missions for which they were specifically designed.

4. The technological development and improvement of the UAV should be encouraged by military leaders with emphasis focused on simple, low cost, durable systems that are able to carry high-tech payloads to a commander's designated area of interest. Advances in payload technology and the development of over-the-horizon capability will provide the UAV with a multitude of new, invaluable capabilities with important operational implications.

5. There is tremendous potential for the use of UAVs in the future. Technology and the imagination are the only limiting factors.

ENDNOTES

[1] J. R. Wilson, "Suddenly Everyone Wants a UAV," Interavia Aerospace Review, December, 1991, p. 43.

[2] IBID.

[3] IBID.

[4] IBID.

[5] Stefan Geisenheyner, "Current Developments in Unmanned Aerial Vehicles," Armada International, May, 1990, p. 74.

Dr. Michael C. Dunn, "Bringing 'em Back Alive," Defense and Foreign Affairs, May 1984, p. 24.

[6] Geisenheyner, p. 76.

[7] IBID.

[8] IBID.

[9] IBID.

[10] Col. Lawrence G. Karch, "CAS, SEAD, and UAVs," Marine Corps Gazette, February, 1990, p. 47.

[11] Geisenheyner, p. 76.

[12] Brian Wanstall and Bill Sweetman, "Unmanned Aircraft Fit Tight Budgets," Interavia Aerospace Review, April, 1990, p. 315.

[13] Geisenheyner, p. 74.

[14] U.S. Joint Chiefs of Staff, Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles, August, 1993, p. I-2.

[15] IBID.

[16] IBID.

[17] IBID.

[18] Geisenheyner, p. 80.

[19] U.S. Joint Chiefs of Staff, p. I-2

[20] Geisenheyner, p. 80.

[21] U.S. Department of Defense, Unmanned Aerial Vehicles (UAV) Master Plan 1993, 31 March 1993, p. 16.

[22] U.S. Joint Chiefs of Staff, p. I-2.

[23] IBID.

[24] Geisenheyner, p. 80.

[25] U.S. Joint Chiefs of Staff, p. I-3.

[26] Geisenheyner, p. 80.

[27] David A. Fulghum, "USAF Pursues Stealthy UAV to Improve Reconnaissance," Aviation Week and Space Technology, January 17, 1994, p. 44.

[28] IBID, p. 46.

[29] U.S. Department of Defense, p. 11.

[30] IBID, p. 36.

[31] IBID.

[32] Pioneer UAV, Inc., "Pioneer UAV," Information Pamphlet.

[33] Geisenheyner, p. 80.

[34] U.S. Department of Defense, p. 36.

[35] IBID, p. 38.

[36] IBID.

[37] U.S. Joint Chiefs of Staff, p. II-16.

[38] IBID.

[39] L. Edgar Prina, "UAVs: The Forward Line of Technology," Sea Power, October, 1989, p. 38.

[40] Michael L. Courtright, "Unmanned Vehicles Go To War," Machine Design, December 12, 1991, p. 60.

L. C. Garrison, "Pioneer in the Gulf War," May 15, 1992, Desert Shield and Desert Storm Anecdotes.

[41] Courtright, p. 61.

[42] IBID.

[43] Garrison, Lessons Learned.

[44] Joint Uniform Lessons Learned System, (JULLS).

[45] U.S. Joint Chiefs of Staff, p. I-1.

[46] IBID.

[47] John D. Morrocco, "Pentagon-CIA UAV Gains New Significance," Aviation Week and Space Technology, November 8, 1993, p. 28.

[48] David A Fulghum and John D. Morrocco, "CIA to Deploy UAVs in Albania", Aviation Week and Space Technology, January, 31, 1994, p. 20.

[49] U.S. Joint Chiefs of Staff, p. II-3.

BIBLIOGRAPHY

Barela, Maximo A. and Jackson, James. "RPV Applications in the U.S. Navy." Student research paper, Air War College, Maxwell Air Force Base, Alabama: 1988.

Courtright, Michael, L. "Unmanned Vehicles Go To War." Machine Design, December 12, 1991, pp. 60-64.

Dunn, Michael C. "Bringing 'Em Back Alive." Defense and Foreign Affairs, May, 1984, pp. 24-27.

Edwards, Lennie O. "A Role for Unmanned Aerial Vehicles on the Modern Tactical Battlefield." Student research paper, United States Army Command and General Staff College, Fort Leavenworth, Kansas: 1990.

Ferriter, Edward C. "Unmanned Aerial Vehicle (UAV) Basing on U.S. Navy Ships." Student research paper, U.S. Naval War College, Newport, R.I.: 1990.

Fulghum, David A. "USAF Pursues Stealthy UAV To Improve Reconnaissance." Aviation Week and Space Technology, January 17, 1994, pp. 44-46.

Fulghum, David A., and Morrocco, John D. "CIA To Deploy UAVs in Albania." Aviation Week and Space Technology, January 31, 1994, pp. 20-22.

Garrison, Les C. "Pioneer in the Gulf War." A compilation of information from Pioneer operating units in the Gulf War, 15 May, 1992.

Geisenheyner, Stefan. "Current Developments in Unmanned Aerial Vehicles." Armada International, May, 1990, pp. 74-86.

Hallam, J. Cyril. "Maritime UAVs, an Overview." Naval Forces, Vol. 13, No. 4, 1992, pp. 42-44.

Harshman, William R. "Army Unmanned Aerial Vehicle (UAV) Requirements and the Joint UAV Program." Student research paper, United States Army Command and General Staff College, Fort Leavenworth, Kansas: 1990.

Joint Uniform Lessons Learned, (JULLS). "Special Operations Use of Remotely Piloted Vehicle."

Joint Uniform Lessons Learned, (JULLS). "Remotely Piloted Vehicles for CVBGs."

Karch, Lawrence G. "CAS, SEAD, and UAVs." Marine Corps Gazette, Vol. 74, February, 1990, pp. 45-52.

Leibstone, Marvin. "U.S. Unmanned Air Vehicles." Military Technology, Vol. 16, September, 1992, pp. 29-32.

Lesser, Roger. "Unmanned Aerial Vehicles-Still a Top DOD Priority." Defense Electronics, March, 1993, pp. 36-44.

Lovece, Joseph A. "Big Plans, High Hurdles for UAV Joint Program Office." Armed Forces Journal International, July, 1990, pp. 47-48.

Lovece, Joseph. "U.S. Military Services Finally Embrace UAVs...Just As Procurement Funds Dwindle." Armed Forces Journal International, July, 1993, pp. 21-23.

Lover, Kevin F. "Unmanned Aerial Vehicles--An Asset For the Operational Commander." Student research paper, U.S. Naval War College, Newport, R.I.: 1990.

Morrocco, John D. "Pentagon-CIA UAV Gains New Significance." Aviation Week and Space Technology, November 8, 1993, pp. 28-29.

Nordwall, Bruce D. "Radar-Equipped UAVs May Aid All-Weather Reconnaissance." Aviation Week and Space Technology, February, 1989, pp. 69-77.

Pioneer UAV Inc. "Pioneer UAV." Information Pamphlet.

Prina, L. Edgar. "UAVs: The Forward Line of Technology." Sea Power, October, 1989, pp. 37-40.

Tapscott, Mark. "New Pictures Emerging in Battlefield Intelligence." Defense Electronics, Vol. 25, April, 1993, pp. 31-38.

U.S. Dept. of Defense. Unmanned Aerial Vehicles (UAV) Master Plan 1993. Washington: 31 March 1993.

U.S. Joint Chiefs of Staff. Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles. Washington: August, 1993.

Wanstall, Brian, and Sweetman, Bill. "Unmanned Aircraft Fit Tight Budgets." Interavia Aerospace Review, Vol. 45, April, 1990, pp. 315-321.

Wilson, J.R. "Suddenly Everyone Wants a UAV." Interavia Aerospace Review, Vol. 46, December, 1991, pp. 43-47.